DOCUMENT RESUME

ED 304 482 TM 012 886

AUTHOR Rathbone, A. Sue

TITLE Gender Differences in Attitudes toward Mathematics between Low-Achieving and High-Achieving Fifth Grade Elementary Students.

PUB DATE Feb 89

NOTE 28p.; Paper presented at the Annual Meeting of the Eastern Educational Research Association (Savannah, GA, February 22-25, 1989).

PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC02 Plus Postage.

DESCRIPTORS *Course Selection (Students); *Elementary School Mathematics; Elementary School Students; *Grade 5; High Achievement; Intermediate Grades; Learning Readiness; Low Achievement; *Preadolescents; Predictor Variables; *Sex Differences; Sex Stereotypes; *Student Attitudes; Urban Schools

IDENTIFIERS Fennema Sherman Mathematics Attitudes Scales

ABSTRACT

Possible gender differences in attitudes toward mathematics were studied between low-achieving and high-achieving fifth-grade students in selected elementary schools within a large, metropolitan area. The attitudes of pre-adolescent children at an intermediate grade level were assessed to determine the effects of rapidly emerging gender-related differences at this developmental stage. A true random sample of 200 students (47 low-achieving males, 49 high-achieving males, 46 low-achieving females, and 58 high-achieving females) was selected from 4,872 students who took the California Achievement Tests in Mathematics during October of 1986. Subjects were administered four domain-specific subscales from the Fennema-Sherman Mathematics Attitude Scales. Structured, audiotaped interviews were also conducted concerning mathematics attitudes. Results indicate that gender was not a statistically significant factor in determining overall student attitudes. However, lower confidence in learning mathematics and a belief in male dominance in the subject contributed to non-election of mathematics courses by females. Self-confidence, positive attitudes toward success, positive teacher and parental attitudes, and stereotyping mathematics as a neutral domain were significant factors in formulating students' overall positive attitudes toward mathematics. Eight data tables are provided, and the student follow-up interview is appended. (TJH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED304482

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
A. Sue Rathbone
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

GENDER DIFFERENCES IN ATTITUDES TOWARD MATHEMATICS BETWEEN LOW-ACHIEVING AND HIGH-ACHIEVING FIFTH GRADE ELEMENTARY STUDENTS

by
A. Sue Rathbone
Baltimore County Public Schools
6901 Charles Street
Towson, Maryland 21204

This paper was presented at the Eastern Educational Research Association Annual Conference, Savannah, Georgia, February 22-25, 1989. The author wishes to express appreciation to Dr. Nancy King and Dr. Elizabeth Fennema for their contributions to this study, and to Dr. Nancy S. Grasmick and the Baltimore County Public School System for their cooperation.

TM012886

INTRODUCTION

The study of mathematics is vital to the intellectual development of a society and to its scientific, industrial, technological, and social progress. Yet powerful societal factors operate to discourage females from continuing in mathematics study (Aiken, 1976; Meece & Parsons, 1982). Thus, a small number of women pursue careers in scientific, mathematical, and technical fields (Meece & Parons, 1982). Despite efforts at amelioration through affirmative action and scholarship programs, employment statistics indicate that men and women continue to enter these fields in disproportionate numbers (Bureau of Labor Statistics, 1980).

Although many factors contribute to this problem, one is of particular interest to educators: gender differences in the mathematical training of students. A strong mathematical background is important for admission to many college majors, for success in many professional occupations, and for employment in many computerized technical occupations. Yet compared with male students, female students are less likely to enroll in advanced high school and college mathematics courses (Ernest, 1976; Sells, 1980).

Female students are not pursuing graduate studies in the field of mathematics. In 1976, only 6 percent of the PhDs in mathematics were awarded to women; a decade later this figure has increased to 14 percent (Tobias, 1982).

Although women may receive less encouragement to continue their mathematical studies, it is not the case that they are systematically excluded through discriminatory course availability. On the contrary, women <u>choose</u> not to enroll in advanced mathematics courses or to

pursue math-related college majors (Meece & Parsons, 1982). The sociological and psychological factors influencing the academic choices of these students appear to play a crucial role in this problem.

Researchers propose that gender differences in mathematical training, mathematical achievement and attitudes toward mathematics are explained by the different socialization experiences of boys and girls (Meece & Parsons, 1982). Teachers, school counselors, and students act as socializers in the educational setting. Male and female socializers differ in their attitudes and behaviors toward mathematics and thus create differences through their power as role models (Tobin & Fox, 1980). These role models, by embracing certain views, can undermine girls' confidence levels, their motivation to perform well, and their actual learning in mathematics (Heller & Parsons, 1981; Parsons, Kaszala & Meece, 1982).

Thus, there are specific attitudinal and sociological factors which influence males and females in the learning of mathematics. These two critical factors were investigated in this study.

Purpose of the Study

The purpose of this study was to investigate possible gender differences in attitudes toward mathematics between low-achieving and high-achieving fifth grade students in selected elementary schools located in a large, metropolitan area. Differences in attitudes, as well as achievement between adolescent male and female students, have been well-documented in research-related literature (Fennema, 1980; Fox, et al., 1982). This investigation compared the attitudes of

preadolescent children at an intermediate grade level. During preadolescence, gender-related differences begin to rapidly emerge (Casserly, 1975; Corbo, 1984).

Earlier research (Aiken, 1972; Dutton, 1954) focused on unidimensional scales measuring a general construct labeled mathematics attitude. The recent trend, however, has been toward the utilization of multidimensional scales measuring a variety of attitudes (Fennema & Sherman, 1976: Pederson, et al., 1986; Verbeke, 1982). Studies using middle and high school subjects are presently using multidimensional scales which measure specific attitudes toward mathematics (Broadbooks et al, 1981; Verbeke, 1982). Recent studies, using elementary students as subjects, however, continue to use a unidimensional scale, which measures a general attitude toward mathematics (Corbo, 1984, Schofield, 1982). This present study used the following multidimensional attitude scales: confidence in learning mathematics, the perception of the teacher's attitude toward one as a learner of mathematics, the student's attitude toward success in mathematics, and mathematics as a male domain. This study was, therefore, unique as it used multidimensional attitude scales to measure fifth grade students' attitudes toward mathematics.

Review of Related Literature

II. Attitude and Achievement

According to the (1979) Boswell study (1985), boys and girls in the third and fourth grades liked mathematics to a similar degree. Fifth and sixth grade boys continued to show the same degree of liking

mathematics, whereas girls declined somewhat. When children were asked about mathematics abilities of their peers, third grade girls generally responded that girls were better in mathematics, and boys typically responded that boys were better. By grades 5 and 6, however, girls began to shift towards judgment of mathematical ability favoring the boys. The results of the study revealed (1) gender differences emerged in children's attitudes toward mathematics in the later elementary years, and (2) by the third grade, children perceived mathematics as a male domain in the adult world (p. 187).

In the Schofield (1982) study, data on the mathematics attitudes and achievement of 1,896 elementary school children were gathered twice during the school year. Relationships between attitude and achievement were considered in connection with sex of the student, grade level, type of arithmetic test, and time during the school year at which the measurements were taken. The relationship between mathematics attitude and achievement among girls was low, only intermittently significant and at all times negative compared with a stronger, more significant and positive relationship among boys.

Students' Differential Experiences

Parents and teachers influence children's achievement behavior and attitudes by the types of general experiences they provide or encourage (Meece & Parsons, 1982). (Conners et al. 1978) argue that the spatial skill deficit shown by girls is a consequence of their lack of experience with activities such as large block play, mechanical toy manipulation, and team sports which require spatial problem-solving. Socializers, especially parents, do not provide

girls with the experiences necessary for spatial skill acquisition. Hilton and Berglund (1974) document that parents purchase more mathematical and spatial games for boys than for girls. Stein and Bailey (1973) argue that moderate nurturance, permissiveness, and encouragement of independence are important child-rearing practices for facilitating achievement in girls.

Confidence in Learning Mathematics

The Parsons, Adler and Kaczala studies (1982) show that children's self-concepts of ability are more directly related to their parents' beliefs about the children's math aptitude and potential rather than the children's own past achievement in mathematics. Although the causal significance of these different perceptions has yet to be assessed, these studies show that students' perceptions of their parental expectations are related indirectly to their intentions to take advanced mathematics courses (Meece & Parsons, 1982).

Girls not only have less confidence in their ability to learn mathematics, but feel mathematics will not be useful to them in the future (Collins, 1985). They also perceive their parents as less positive toward them as mathematic students. These factors may indicate reasons why girls fail to elect upper-level mathematic courses in high school and college (Sherman, 1980).

Mathematics as a "Male Domain"

The study of mathematics is decreed masculine not only in the United States and Canada, but in most Western countries in the world (Fox, 1979). Mathematics is sterotyped as a male domain in the higher

socioeconomic levels in Western cultures (Sherman, 1976). At the lower socioeconomic levels girls exhibit a positive attitude toward mathematics since learning is considered a female domain in the lower class. The situation is reversed in the higher socioeconomic society where learning is considered a male domain and girls have negative asttitudes toward mathematics (Sherman, 1976). These sterotypic feelings are transmitted by parents to elementary students and by peers to secondary students (Broverman, et al., 1972).

Verbeke (1982) reports that gifted males sterotype mathematics as a "male domain" much more significantly than gifted girls. Sherman (1976) and Leder (1982), on the other hand, note that high-achieving females see mathematics as male-dominated. Females aspire to success, but at the same time, struggle with the possible loss of feminity and social rejection.

Sample

This study was conducted in a large, metropolitan school system. There were ninety-three elementary schools located in this district, with approximately 5,229 fifth grade elementary school students. A true random sample of 200 fifth grade students was selected utilizing a chart of random numerals. The sample was selected from the 4,872 fifth grade students who took the California Achievement Tests - Mathemtics (CAT-M) during October, 1986. This true random sample consisted of 47 low-achieving males, 49 high-achieving males, 46 low-achieving females, and 58 high-achieving females. The 96 male subjects and 104 female subjects were identified as low-achieving or high-achieving students by their total mathematics stanine scores.

Table 1

Participation of Fifth Grade Males and Females by Achievement Levels

Group	N	Achievement Level: Low (stanine 1,2,3,)	High (stanine 9)
Males	96	47	49
Females	104	46	58
Total	200	93	107

N = 200

Subjects were administered four domain-specific subscales from the Fennema-Sherman Mathematics Attitude Scales (Fennema & Sherman 1976). These multidimensional scales measure important, domain-specific attitudes which have been hypothesized to be related to the learning of mathematics by all students and/or the cognitive performance of females (Fennema & Sherman, 1976).

The following, four domain-specific scales were deemed most appropriate to measure fifth grade students' attitudes: Attitude toward Success (AS), Confidence in Learning Mathematics (C), Mathematics as a Male Domain (MD), and Teacher (T) Scale (E. Fennema, personal communication, April 5, 1986). Each scale consisted of six positively stated and six negatively stated items, with four response alternatives: strongly agree, agree, disagree, and strongly disagree.

Each response was given a score 1-4 and on each scale, except the Male Domain Scale, the weight of 4 was assigned to that response that

was hypothesized to have a positive effect on the learning of mathematics.

Quantitative Data

Six research hypotheses were formulated to compare the attitude scores between six student groups. The statistical analysis was performed using independent t-tests to calculate the differences between mean attitude scores for the following groups: total fifth grade students, total males and females, low-achieving males, high-achieving males, low-achieving females, and high-achieving females. The four individual domain-specific attitude scores as well as the total score were used to compare differences between the male and female groups as well as the low- and high- achieving groups. The independent variables were gender and mathematics aschievement. The dependent variable was attitude toward mathematics by total scale and by sub-scale.

In addition, this study attempted to find the correlations across the four domain-specific attitudes and across the following seven groups: fifth grade students, male students, female students, low-achieving males, high-achieving males, low-achieving females, and high-achieving females. Pearson's product-moment correlation coefficients were generaterd for all possible combinations of attitudes, thus determining significant relationships across five attitudinal variables and across the seven groups.

Qualitative Data

Structured interviews were also conducted by the researcher

concerning these students' attitudes toward mathemtics. Twenty fifth grade students were selected from the random sample of 200 students. In this sample, students were equally represented in the four groups: low-achieving males; high-achieving males; low-achieving females, and high-achieving females.

In this study, the interview was an audiotaped discussion in which the interviewer provided the respondents with open, direct, and closed questions. The questions focused on the following topics:

a. Student's overall attitude towards mathematics.

b. Student's attitude toward his/her success in mathematics.

c. Student's confidence level in mathematics.

d. Student's perception of mathematics as a male, female, or neutral domain.

e. The influence of significant others toward the student as a learner of mathematics.

The transcripts of the taped interviews were analyzed in several different ways. A summary of responses for each question was made and page references to individual transcripts were noted. Answers were categorized and comparisons between males and females and between high- and low-achieving interviewees were completed to determine similarities or differences in response. The analysis of these data gave substance and helped to interpret the quantitative data recieved from the Fennema-Sherman Mathematics Attitude Scales.

Results

Sumamry of Quantitative Analysis - Independent T-Tests

An analysis of the independent t-test scores indicated that students' confidence levels were influential in determining their

overall attitudes toward mathematics. The high-achieving student groups were more sterotypic of mathematics as a male domain than were low-achieving students. High-achieving students reflected more positive attitudes toward mathematics than did low-achieving students. The difference was statistically significant. (See Table 2).

Table 2

A Comparison of Mean Scores Between Low-Achievement and High-Achieving Students on the Fennema-Sherman Total Mathematics Attitude Scale and Subscales

	Low	High	t-value
AS/AS	38.4	42.0	-4.87***
C/C	31.2	43.4	-13.35***
T/T	33.48	38.50	-5.53***
MD/MD	36.38	43.06	-8.43***
Total/Total	139.49	167.02	-12.75***

Total N = 200; Low - 93; High = 107

* p < .05; ** p < .01; *** p < .001

Gender was not a statistically significant factor in determining overall student attitudes. However, the three male student groups significantly stereotyped mathematics as a male domain; thus, the three female student groups were less stereotypic in their attitudes toward mathematics (See Tables 3, 4, and 5). the lowest of the domain-specific attitude scores for the fifth grade females was the score for the Teacher Scale. Males, more than females, perceived of their teachers as viewing them as learners of mathematics. This difference, however, was not statistically significant (See Table 3).

Table 3

A Comparison of Mean Scores Between Fifth Grade Males and Females on the Fennema-Sherman Total Mathematics Attitude Scale and Subscales

	Male	Female	t-value
AS/AS	40.68	40.07	.78
C/C	38.16	37.36	.64
T/T	36.80	35.58	1.25
MD/MD	38.51	41.28	3.07**
Total/Total	154.15	154.29	.049

Total N = 200; Males = 96; Females = 104

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 4

A Comparison of Mean Scores Between Low-Achieving Males and Females on the Fennema-Sherman Total Mathematics Attitude Scale and Subscales

	Male	Female	t-value
AS/AS	39.34	37.48	1.59
C/C	32.30	30.11	1.42
T/T	34.34	32.60	1.23
MD/MD	35.57	37.20	1.39**
Total/Total	141.55	137.39	1.25

Total N = 93; Low Males - 47; Low Females = 46

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 5

A Comparison of Mean Scores Between High-Achieving Males and Females on the Fennema-Sherman Total Mathematics Attitude Scale and Subscales

	Male	Female	t-value
AS/AS	41.96	42.12	1.17
C/C	43.78	43.10	.64
T/T	39.16	37.94	1.04
MD/MD	41.33	44.52	3.09**
Total/Total	166.22	167.69	-.52

Total N = 107; High Males = 49; High Females = 58

* $p > .05$; ** $p < .01$; *** $p < .001$

Interrelationship of Domain-Specific Attitudinal Variables

Relationships between the attitudinal variables of Attitude toward Success, Confidence in Learning Mathematics, Teacher Attitude, Mathematics as a Male Domain, and Total Attitudes were performed by calculating a Pearson product-moment correlational coefficient between the paired attitudinal variables for seven independent groups. Ten correlation coefficients were generated for each group. Comparative data were reported for total grade level, gender group and for achievement levels. Forty-four correlations were found to be statistically significant for the seven student groups. (There was a lack of signifance reported in only sixteen of the sixty cells for the seven matrices). Those domain-specific or total attitude combinations which reported positive correlations from .40 to 1.00 were analyzed as showing a real or significant relationship. Correlation coefficients were interpreted utilizing Koenker's (1971) scale:

.80 to 1.00 - a highly dependable relationship

.60 to .79 - a moderate to marked relationship

.40 to .59 - a fair degree of relationship.

All statistically significant correlations for the attitudinal combinations for the seven independent groups fell between .242 and .837. The following data are highlighted as exhibiting statistically significant correlations:

- o Fifth Grade Students - Confidence Level and Total Attitude
  Confidence and Teacher Attitude
- o Fifth Grade Males - Confidence Level and Total Attitude
  toward Success and Teacher Attitude

- o Fifth Grade Females - Confidence level and total attitude
  Confidence and Teacher Attitude
- o Low-Achieving Males - Attitude toward Success and Total Attitude
- o High-Achieving Males - Teacher Attitude and Total Attitude
  Confidence Level and Teacher Attitude
- o Low-Achieving Females - Confidence Level and Total Attitude
  Confidence Level and Teacher Attitude
- o High-Achieving Females - Teacher Attitude and Total Attitude

*All of these intercorrelations were significant at the $p < .01$ level.

Fifth grade males' overall mathematics attitude was significantly affected by their confidence level in learning mathematics. Confidence level showed a statistically significant relationship in determining fifth males' attitude toward success in mathematics, and also significantly affected males' perceptions of their teachers' atttitudes toward them as mathematics learners (See Table 6). How stereotypic fifth grade males were toward the subject of mathematics had a slight effect in determining their confidence levels, their attitudes toward success in mathematics, their perceptions of their teacher's attittude toward them as well as their overall attitudes toward mathematics.

Fifth grade females' overall atttitudes toward mathematics were most significantly affected by their confidence levels. These

findings were in tandem with the findings for fifth grade males (See Table 7). Both groups reported highly dependable relationships ($r = .803$; $r = .871$).

Table 6

Pearson Product-Moment Correlations for the Fennema-Sherman Mathematics Attitude Scale (Total) and for Subscales -- Fifth Grade Males

	AS	C	T	MD	Total
AS					
C	.387**				
T	.489**	.466**			
MD	.285**	.369**	.287**		
Total Score	.690**	.803**	.761**	.438**	

N = 96 * < .05; ** p < .01

Table 7

Pearson Product-Moment Correlations for the Fennema-Sherman Mathematics Attitude Scale (Total) and for Subscales -- Fifth Grade Females

	AS	C	T	MD	Total
AS					
C	.362**				
T	.307**	.573**			
MD	.324**	.491**	.292**		
Total Score	.627**	.871**	.749**	.686**	

N = 104 * p < .05; ** p < .01

The most dependable of the males' domain-specific attitudes was the relationship found between attitude toward success and the teacher's attitude (Table 6). The most dependable of the females' domain-specific attitudes was the relationship found between their confidence levels and the teacher's attitude (See Table 7).

Summary of Qualitative Data - Structured Interviews

Ten interview questions (See Appendix) were designed to elicit information concerning factors associated with twenty students' attitudes toward mathematics. The questions concentrated on the following seven areas:

i. overall attitude toward mathematics (question #1).
ii. influences of significant others (question #2).
iii. perceived teacher's attitude toward student as a learner of mathematics (questions #2, 3).
iv. attribution of success in mathematics (question #4).
v. mathematics as a male domain (questions #4a, 4b, 4c, 5).
vi. confidence in learning mathematics (questions #6, 7, 8).
vii. attitude towartd success in mathematics (questions #9, 10).

More than half of the fifth grade interviewees acknowledged that they liked mathematics (7 males and 5 females). One-fifth of the interviewees' opinions had been formed as early as first grade. Strong negative and/or strong positive opinions toward mathematics were attributed to the interviewees' perceptions of their mathematics teachers' attitudes toward them as learners of mathematics.

Seven of the interviewees believed that their fathers had a positive effect on influencing their attitudes toward mathematics.

Four of the interviewees (high-achieving students) viewed their fathers as positive role models. These students expressed a desire to pursue similar careers as their fathers.

More than half of the interviewees perceived that their teachers held a positive attitude toward them as learners of mathematics. Most of these students, however, were ranked as either high-achieving or low-achieving males students. Males, more than females, reported receiving special attention from their mathematics teachers. Females, on several occasions, reported that teachers ignored them, called on them less frequently in the mathematics class and gave them little encouragement.

When mathematics was examined as a field of study, nineteen of the twenty interviewees believed that mathematics was appropriate for both boys and girls, thus, most of the male and female interviewees perceived it as a "neutral" domain. However, when the usefulness of mathematics was examined in the adult world, interviewees perceived mathematics to be a "male" domain. One-half of the male interviewees (N=5) believed that mathematics was more useful for men than for women. Six female interviewees sterotyped it as a male domain (See Table 8).

Male interviewees, more frequently than female interviewees, rated their achievement in mathematics as "doing well" or between "well" and "very good." High-achieving males frequently informed the researcher that they were in an accelerated (academically talented) mathematics program which had been designed by the local school district. Female interviewees, on the other hand, gave more

modest responses in reference to rating their own mathematics achievement. Low-achieving females, in contrast to low-achieving males, rated themselves as below average, based on their report card grades. Low-achieving males gave themselves higher self-ratings.

In conclusion, the data collected from the interviewees' attitude surveys as well as the information gleaned from the twenty students' structured interviews indicated that confidence in learning mathematics had a signfiicant influence in determining the interviewees' overall attitudes toward mathematics. These students' perceptions of their teachers' attitudes toward them as learners of mathematics also played a substantial role in forming positive and/or negative atttitudes toward mathematics.

Table 8

Results of Twenty Interviewees' Responses for Mathematics as a Male Domain

Gender and Achievement Level	Ability to Figure Important Calculations			Study of Math - Appropriateness for Gender			Usefulness of Mathematics for Men and Women		
	Men	Women	Both	Boys	Girls	Both	Men	Women	Both
Males									
High	5	0	0	0	0	5	3	1	1
Low	3	0	2	1	0	4	2	1	2
Females									
High	3	0	2	0	0	5	3	0	2
Low	5	0	0	0	0	5	3	0	2

N = 20

Conclusions

The results of this study substantiate previous findings (Fennema & Sherman, 1978) that factors known to contribute to the non-election of high school mathematics courses by males and females are lesser confidence in learning mathematics as well as males' belief that mathematics is a male domain. Self-confidence, positive attitudes toward success, the usefulness and appropriateness of mathematics, positive teacher and parental attitudes as well as sterotyping mathematics as a neutral domain were found to be significant factors in formulating students' overall positive attitudes toward mathematics. These attitudes were shown to be interrelated and were quite complex in nature.

Recommendations

Students in this study expressed their need for more encouragement and support from classroom teachers. The following recommendation follows:

.Elementary school teachers need to be trained to identify the mathematical and scientific ability in students from both sexes. To accomplish this task, teachers need adequate backgrounds for teaching mathematics. In order to provide both high and low-achieving students with an equal opportunity for enrichment, advancement and and appropriate remediation, the development of a well-

designed, comprehensive training program is recommended.

The results of this study produced differences between males' and females' attitudes toward the sterotyping of mathematics. Males in the quantitative portion of this study stereotyped mathematics as a male domain. Much effort in recent years has been made to increase the awareness of females, particularly high-achieving females, to remain "open" to the appropriateness of mathematics as a field of study; however, in an effort to increase this awareness, both males and females have failed to see the usefulness of mathematics for females and/or for both sexes. The following recommendations are made:

.Steps should be taken to increase pre-adolescent students' awareness of the usefulness of mathemtics in the adult world. Teachers, parents and students should be provided with innovative intervention programs (e.g., Project Equals, University of California at Beerkeley; Project Multiplying Options and Subtracting Bias, University of Wisconsin, Madison) in an effort to enhance all students' confidence levels and their overall attitudes toward success in mathematics.

.Preadolescent males should be educated that mathematics is not a male domain but, in fact, is a neutral domain and should be a field open to both sexes. The following recommendation is made:

.Appropriate female role models (women mathematicians and scientists) should be made available to address elementary

mathematics teachers at workshops and at school district meetings. This can be accomplished by utilizing the State Department of Education's curriculum consultants, the National Council of Teachers of Mathematics (NCTM-Reston, Virginia) and IBM's Association Committee on Secondary School Lecturers.

REFERENCES

Aiken, L.R., Jr. (1976). Update on attitudes and other affective variables in learning mathemtics. Review of Educational Research, 46(2), 293-311.

Boswell, S.L. (1979, April 8). Nice girls don't study mathematics: perspective from elementary school. Paper presented at the American Educational Research Association, San Francisco, California, ED 174 477.

Boswell, S.L. (1985). "The influence of sex-role stereotyping on women's attitudes and achievement in mathematics." In S.F. Mathemtics: Balancing the Equation (pp. 184-187). New Jersey: Lawrence Eribaum Associates.

Broverman, I.K., Vogel, S.R., Broverman, D.M., Clarkson, R.E. & Rosenkrantz, P.S. (1972). Sex-role stereotypes: A current appraisal. Journal of Social Issues, 28, 59-78.

Bureau of Labor Statistics. (1980). Monthly employment and earnings. Washington, D.C.: U.S. Department of Labor.

Casserly, P.L. (1975, July). An assessmentt of factors affecting female participants in advanced placement programs in mathematics, chemistry, and physics. (Grant No. GY-11375). Washington, D.C.: National Science Foundation.

Collins, E.L. (1985). Ability, academic achievement, and aspiration of mathematically gifted males and females Unpublished doctoral dissertation, University of Maryland, College Park, Maryland.

Conners, J.M., Schackman, M.E., & Serbin, L.A. (1978). "Sex-related differences in response to practice on a visual-spatial test and generalization to a related test." Child Development, 49, 24-29.

Corbo, N.J. (L984). Mthematics atttitude and achievement in grades five through seven in a south central Pennsylvania school district. Dissertation Abstracts International, 45, 06A. (University Microfilms No. 84-20432)

Ernest, J. (1976). Mathematics and sex. American Mathematics Monthly, 83, 595-613.

Fennema, E. (1980, March). Teachers and sex bias in mathematics. Mathematics Teacher, 169-173.

Fennema, E. (1981). The sex factor. In R.S. Brandt (Ed.), Mathematics educational research: Implications for the 80's Reston, Virginia: National Council of Teacher of Mathematics.

Fennema, E. & Sherman, J. (1976). Fennema-Sherman Mathematics Attitude Scales: Instruments designed to measure attitudes toward the learning of mathematics by males and females. (JSAS Catalog of Selected Documents in Psychology. 6.1.31. Ms. No. 1225).

Fennema, E. & Sherman, J. (1978, May). Sex-related differences in mathematics achievement and related factors: A further study. Journal for Research in Mathematics Education, 189-203.

Fox. L.H. (1979). Gifted females: Are we meeting their counseling needs? Personnel and Guidance Journal, 57, 256-9.

Heller, K.A. & Parsons, J.E. (1981). "Sex differences in teachers' evaluative feedback and students' expectancies for success in mathematics." Child Development, 52 1015-1019.

Hilton, T.L. & Berglund, G.W. (1974). Sex differences in mathematics achievement: A longitudinal study. The Journal of Educational Research, 67(5), 231-237.

Leder, G.C. (1982). Mathematics achievement and fear of success. Journal for Research in Mathematics Education, 13(2), 124-135.

Meece, J. & Parsons, J. (1982). Sex differences in mathematics achievement: Toward a model of academic choice. Psychological Bulletin, 90(2), 324-348.

Parsons, J.E., Adler, T.F., Kaczala, C.M. & Meece, J.L. (1982). Sex differences and Learned helplessness. Sex Roles.

Parsons, J.E., Kaczala, C.M. & Meece, J.L. (1982). "Socialization of achievmeent attitudes and beliefs: Parentsl Influences." Child Development, 53 322-339.

Pederson, K., Tayet, C., Elmore, P., & Bleyer, D. (1986, April). Causal models of continuation in the mathematics study sequence. Paper presented to the 64th Annual Meeting of the National Council of Teachers of Mathematics, Washington, D.C.

Schofield, H.L. (1982). "Sex, grade level, and the relationship between mathematics attitudes and achievement in children." Journal of Educational Research, 75, 280-284.

Sells, L. (1980). The mathematical filter and the education of women and minorities. In H. Fox, L. Brody and D. Tobin (Eds.). Women and the mathematical mystique. Baltimore, Maryland: The Johns Hopkins University Press.

Sherman, J.A. (1976). Girls' attitudes toward mathematics: Implications for counselling (Report No. 134-921). ERIC Documentt Reproduction Service.

Sherman, J.A. (1980). "Mathematics spatial visualization and related factors: Changes in girls and boys, grades 8-11." Journal of Educational Psychology, 92, 476-482.

Stein, A.H. & Bailey, M.M. (1973). The socialization of achivement orientation in females. Psychological Bulletin, 80, 345-366.

Tesch, R. (1975, December). The humanistic approach to educational research. Santa Barbara, California. The Fielding Institute. (ERIC Document Reproduction Service No. ED 140 475)

Tobias, S. (1982, January). Sexist equations. Psychology Today, 1614-1617.

Tobin, D. & Fox, L.H. (1980). Career interests and career education: A key to change. In L.H. Fox, L. Brody, and D. Tobin (Eds.) Women and the mathematical mystique. Baltimore, Maryland: The Johns Hopkins University.

Verbeke, K.A. (1982). Sex-related differences in mathematically gifted secondary students: An investigation of selected cognitive, affective, and educational factors. Unpublished doctoral dissertation, Unviersity of Maryland, College Park, Maryland.

APPENDIX

FOLLOWUP INTERVIEW

Name _____ Date _____

Attitudes Toward Mathematics

1. Do you like mathematics (If Yes or No)

   a. Why do you feel this way?

   b. How long have you liked (disliked) math?

(T) 2. People often remember a special person who helped them form an opinion about math.

   a. Describe any special person in your life who has influenced you to like or dislike math. (Describe this person's relationship to you such as 4th grade teacher, my mother, etc.)

   b. How did this person influence your feelings about math?

   c. Was there any special experience(s) in your life that helped you become interested (or disinterested) in math?

   d. How did this experience influence your feelings or attitude toward math?

(T) 3. Do you think your math teacher takes you seriously (as a learner of mathematics)?

   a. Why?

      (If yes): What kind of encouragement do you get in math class?

   b. (If no): Why?

      (If no): How do you know that your math teacher doesn't encourage you?

(MD) 4. What kind of a person does well in math?

   a. Do you think that boys are better in mathematics than girls?

      (If yes): Why?

      (If no): Do you think girls are better than boys in math? Why?

b. Can a woman figure out important calculations (computations)?

Can a man figure out important calculations (computations)?

c. Do you believe that math is more useful to boys than girls?

(If yes or no): Why?

(MD) 5. Is the study of mathematics just as appropriate (suitable) (acceptable) for women as for men?

(C) 6. How would you describe your achievement (performance) in math?

How do you know?

(C) 7. Generally, do you feel good about trying math?

(If no): Why?

(If yes): In what ways do you feel self-confident?

(C) 8. Can you do more difficult or advanced math, if you try?

(If no): Why do you feel this way?

(AS) 9. Do you think people would like you more or less if you were a really good math student?

Why?

(AS) 10. Would it make you happy (or unhappy) to be recognized in some way as an excellent student in math? (noticed)

Why?

*Questions coded:

(AS) Attitude toward Success in Math

(C) Confidence in Learning math

(T) Teacher's Attitude Toward One as Learner of Math

(MD) Math as a Male Domain